International Journal of Agricultural Science and Research (IJASR)
ISSN (P): 2250-0057; ISSN (E): 2321-0087
Vol. 7, Issue 4, Aug 2017, 663-668

GROWTH, YIELD AND YIELD ATTRIBUTES OF SUMMER GREEN GRAM (*VIGNA RADIATA* L.WILEZECK) UNDER MEDIUM BLACK CALCAREOUS SOILS AS INFLUENCED BY APPLICATION OF SULPHUR AND ZINC LEVELS

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ABSTRACT

A field experiment was conducted at the Instructional Farm, College of Agriculture, Junagadh Agricultural University, Junagadh during summer season of 2014, to assess the response of summer green gram (Vigna radiata L. Wilezeck) to four levels of sulphur viz., 0, 10, 20 and 30 kg S ha^{-1}, and three levels of Zinc viz., 0, 2.5 and 5.0 kg Zn ha^{-1}. The results of different sulphur and zinc levels depicted that application of 30 kg S ha^{-1} and 5.0 kg Zn ha^{-1} significantly increased the plant height, number of branches per plant, number of pods plants, number of seeds per pod, number of root nodules per plant, seed and straw yield. Sulpur also increased the dry weight of root nodules, 100 seed weight. The interaction effect of sulpur and zinc and produced the significant results on seed and straw yield.

KEYWORDS: Summer Green Gram, Sulphur Levels, Zinc Levels, Growth Parameters, Yield & Yield Attributes

Received: Jul 03, 2017**; Accepted:** Jul 27, 2017**; Published:** Aug 07, 2017**; Paper Id.:** IJASRAUG201786

Original Article

INTRODUCTION

Mung bean (*Vigna radiata* L. Wilezeck) is one of the important pulse crops of India. Green gram (*Vigna radiata* L.), commonly known as “Mung” or “Mungbean” is one of the most important pulse crops in India, ranking fourth in respect of cultivated area. India alone accounts for 65 per cent of its world acreage and 54 per cent of the production. Sulphur, an essential secondary plant nutrient, is required by plant and animals in approximately the same amount as phosphorus. On an average, the amount of sulphur content in the earth crust is ranged about 0.06 to 0.10 per cent. Pulses are particularly responsive to sulphur containing fertilizers, and that elementary sulphur or sulphates increases the percentage of nitrogen as well as yield on such deficient soils. Zinc useful in production of growth hormones, elongation of the nodes and in the chloroplast and starch grain is effective. Spraying micronutrient is beneficial for the growth of green grams and its quality (Khorgami and Farnia, 2006).

The Saurashtra region of Gujarat is being highly influenced by the vagaries of monsoon, which results in low and unstable crop yields. The region faces twin problems of poor fertility and inadequate moisture availability for crop production that results in partial or total failure of crop, with occurrence of mild to severe drought. At the same time, management of sulphur and zinc is must to achieve potential green gram production.

MATERIAL AND METHODS

The experiment was conducted during *rabi*, season 2013-14 in D-5 plot of Instructional Farm at Krushigadh College of Agriculture, Junagadh Agricultural University, Junagadh. The experiments were laid out in Factorial Randomized Block Design having 12 treatments with three replications. The experiment consisted of 4

levels of sulphur (0, 10, 20 and 30 kg S ha^{-1}) and 3 levels of zinc (0, 2.5, 5 kg S ha^{-1}).

The soil of the experimental field was medium black calcareous soil with pH 8.0 and EC 0.57 dS m^{-1}. The crop was fertilized with sulphur and zinc as per treatment allotted to each plot in the form of Cosavet fertis, WG (90%) and ZnO in basal application. Green gram, GM- 4 variety was used as planting material in this study. The seeds were dibbled at a spacing of 30×10 cm using a seed rate of 20 kg ha^{-1} during the first week of February.

Five plants were selected at random from each plot to record individual plant nutrient content and uptake by some analyses in the leaves, shoot, root and seed. The soil analysis was carried out according to standard methods. The soil used in the experiment was clayey in texture, containing 35.16, 2.97 and 61.87% sand, silt and clay, respectively. The pH, EC (25°C) and available N, P, K, S and Zn were 8.0, 0.57 dS m^{-1} and 207.30 kg ha^{-1}, 36.80 kg ha^{-1}, 185.70 kg ha^{-1}, 14.38 kg ha^{-1} and 0.77 kg ha^{-1} respectively. In general, the experimental soil was medium in N as well as K and low in P and S.

RESULTS AND DISCUSSIONS

Effect of Sulphur

Application of sulphur produced significant effect on yield attributes (Table 1) viz., plant height, number of branches per plant, number of pod per plant, number of seeds per pod and test weight of green gram. Significantly, the higher values of these attributes were recorded under 30 kg Sha^{-1} (S_3) as compared to those of control (S_0) and 10 kg S ha^{-1} (S_1); however, generally, they were at par with 20 kg S ha^{-1} (S_2). The values registered for these parameters from control (S_0) and 10 kg S ha^{-1} (S_1) were generally at par with each other. The beneficial effect of application of sulphur on growth and yield attributes might be due to the fact that sulphur application improved over all nutritional environment of the *Rhizosphere* as well as plant system, which could be more advantageous for profuse vegetative and root growth which activate higher absorption of nutrients from the soil. Increase in growth and yield can be ascribed to cell division, enlargement and elongation resulting in overall improvement in plant organs associated with faster and uniform growth of plant under sulphur application. All these had resulted into higher yield attributes. The results confirmed to reports of Salvi *et al*. (1992) and Jat and Rathore (1994) in green gram, Ravichandran *et al.* (1995) in blackgram, Shekhawat *et al.* (1996), Shivram *et al.* (1996), Bhadoria *et al.* (1997), Kumawat and Khangarot (2002) in clusterbean and Singh *et al*. (2004) in chickpea.

The number of root nodules and its dry weight per plant were significantly affected due to application of sulphur, which were recorded significantly higher under sulphur level S_3 (30 kg S ha^{-1}), but statistically at par with that of 20 kg S ha^{-1} (S_2). The non-significant difference in number of root nodules and dry weight of root nodules per plant was found between control (S_0) and 10 kg S ha^{-1} (S_1). The increase in number of root nodules and dry weight of nodules per plant could be attributed to its pivotal role in regulating the metabolic and enzymatic processes including photosynthesis and respiration. Due to good *Rhizosphere*, more activities of micro-organism in soil, so increase in number of nodules $plant^{-1}$. The results are in line of the results of those reported by Singh *et al.* (2004) in chickpea.

Seed and straw yield of green gram was significantly increased with increasing levels of sulphur, wherein, seed and straw yield recorded due to application of sulphur @ 30 kg S ha^{-1} (S_3) was significantly higher as compared to control (S_0) and 10 kg S ha^{-1} (S_1). Sulphur is an essential element which increases root growth, promote nodules formation and stimulates seed formation ultimately resulting into better growth and development of the crop plants, which might have increased the values of growth and yield attributes viz., plant height, number of pods per plant, number of seeds per pod

and test weight, which had combined effects on seed and straw yield. The results are in close agreement with the findings of Jat and Rathore (1994) and Singh and Yadav (2000) in green gram, Ravichandran *et al.* (1995) in blackgram, Shekhawat *et al.* (1996), Shivram *et al.* (1996), Bhadoria *et al.* (1997), Kumawat and Khangarot (2002) in clusterbean, Sepat and Yadav (2008) in mothbean and Gurjar (2012) in soybean.

Effect of Zinc

Application of zinc produced significant effect (Table 1) on plant height, number of branches per plant, number of pods per plant and number of seeds per plant. The values for these parameters noticed due to application of 5.0 kg Zn ha^{-1} (Zn_2) was significantly higher than control (Zn_0) and 2.5 kg Zn ha^{-1} (Zn_1). This might be due to the fact that zinc application improved over all nutritional environments of plant, which improves the growth and development of plant. It plays role in initiation of primordial for reproductive parts and partitioning in of photosynthesis towards them, resulted in better flowering and fruiting. Similar results were reported by Singh and Singh (1995) in soybean, Kalyanaraman and Sivagurunath (1993) in green gram, and Meena *et al.* (2001) in clusterbean

The dry weight of root nodules per plant did not reach to the level of significance due to different rates of zinc application but, the number of root nodules per plant was significantly affected due to zinc levels. Significantly, the highest number of root nodules per plant was observed with the application of 5.0 kg Zn ha^{-1} (Zn_2) as compared to control (Zn_0) and 2.5 kg Zn ha^{-1} (Zn_1). The increase in number of root nodules per plant could be attributed to its pivotal role of zinc in regulating the metabolic and enzymatic processes, including photosynthesis and respiration. Balance nutrition provides good *Rhizosphere* around roots, so increase in number of nodules $plant^{-1}$. Quah *et al.* (1996) reported the similar results in green gram, Kushwah (1993) in urdbean and Meena *et al.* (2001) in clusterbean.

The seed and straw yield of green gram was significantly increased with increasing levels of zinc, wherein, significantly the highest seed and straw yield was registered under the application of 5.0 kg Zn ha^{-1} (Zn_2). Zinc is an essential element, which increases root growth, promote root nodulation and stimulates seed formation ultimately resulting into better growth and development of the crop plants. Zinc also play vital role in metabolic activities in plant system. Kalyanaraman and Sivagurunath (1993), Quah *et al.* (2004) in green gram, Khorgamy and Farnia (2006) in chickpea and Sharma *et al.* (2004) in cluster bean reported similar results.

Interaction Effect

The S x Zn interaction was found non-significant on growth and yield attributes (Table 2), but it was found significant on seed and straw yield of green gram (Figure 1 and 2). Treatment combination of 30 kg S and 5.0 kg Zn ha^{-1} (S_3Zn_2) recorded significantly the highest seed (1162 kg ha^{-1}) and straw (2064 kg ha^{-1}) yield, whereas control of both the factors (S_0Zn_0) recorded the minimum seed (791 kg ha^{-1}) and straw (1473 kg ha^{-1}) indicating synergistic effect of S and Zn on crop yield. Similar results were also reported by Krishna (1995), Srivastav *et al.* (2006) and Ram and Katiyar (2013) in green gram.

Table 1 Effect of Sulphur and Zinc on Growth, Yield and Yield Parameters of Popcorn

Treatments	Plant Height (cm)	Number of Branches Plant^{-1}	Number of Pods Plant^{-1}	Number of Seeds Pods^{-1}	Number of Root Nodules Plant^{-1}	Dry Weight of Root Nodules (mg Plant^{-1})	Test Weight (g)	Yield (kg ha^{-1})	
								Seed	Straw
Levels of Sulphur (kg ha^{-1})									
S_0: 00	39.38	10.01	17.40	10.57	27.21	35.36	34.53	895	1674
S_1: 10	41.65	11.07	17.54	10.49	28.07	36.98	35.16	932	1770
S_2: 20	43.52	11.24	19.69	11.30	29.77	38.43	35.89	964	1892
S_3: 30	46.52	12.28	19.73	11.67	30.69	40.18	36.47	1086	1934
S. Em. ±	1.28	0.29	0.56	0.25	0.80	0.92	0.35	25	29
CD (P = 0.05)	3.77	0.84	1.64	0.74	2.33	2.69	1.02	72	84
Levels of zinc (kg ha^{-1})									
Zn_0: 0	40.97	10.68	16.92	10.50	27.50	37.28	35.15	910	1712
Zn_1: 2.5	42.28	11.16	18.78	10.69	28.79	37.78	35.46	974	1829
Zn_2:5.0	45.06	11.61	20.06	11.84	30.51	38.15	35.93	1023	1911
S. Em. ±	1.11	0.25	0.48	0.22	0.69	0.79	0.30	21	25
CD (P = 0.05)	3.26	0.73	1.42	0.64	2.02	NS	NS	62	72
S × Zn Interaction	NS	NS	NS	NS	NS	NS	NS	Sig.	Sig.
CV %	9.01	7.74	9.01	6.86	8.25	7.29	2.95	8.0	5.0

Table 2: Interaction Effect of S and Zn Seed and Straw Yield

Level of Zinc	Level of Sulphur			
	S_0	S_1	S_2	S_3
Seed Yield (kg ha^{-1})				
Zn_0	917	791	933	998
Zn_1	899	947	954	1098
Zn_2	868	1059	1004	1162
S. Em. ±	43			
CD (P = 0.05)	125			
C.V. %	8.0			
Straw Yield (kg ha^{-1})				
Zn_0	1473	1747	1844	1784
Zn_1	1742	1779	1840	1953
Zn_2	1806	1783	1991	2064
S. Em. ±	49			
CD (P = 0.05)	145			
C.V. %	5.0			

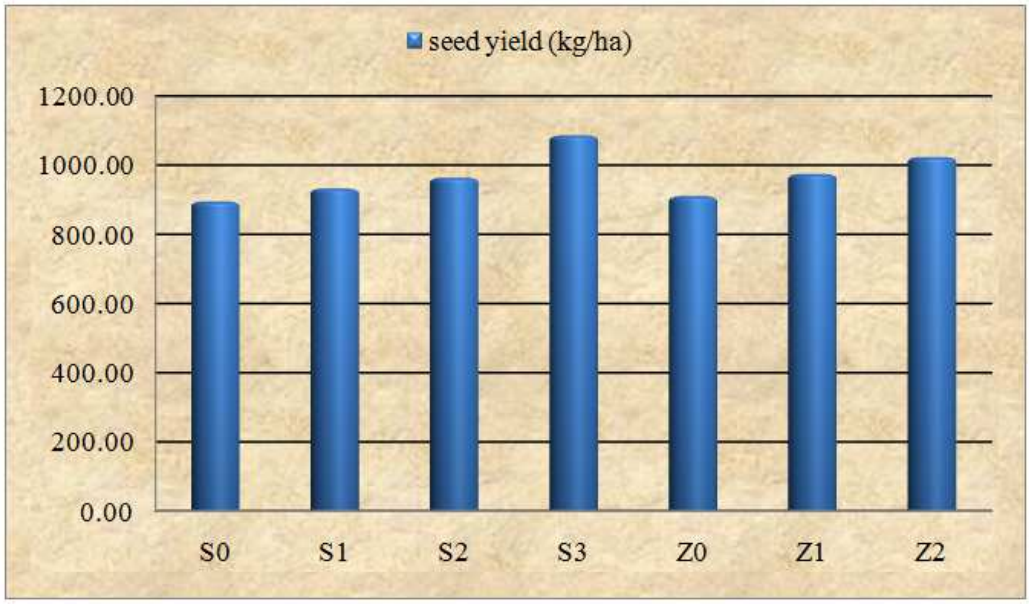

Figure 1: Effect of Sulphur and Zinc on Seed Yield (kg ha^{-1})

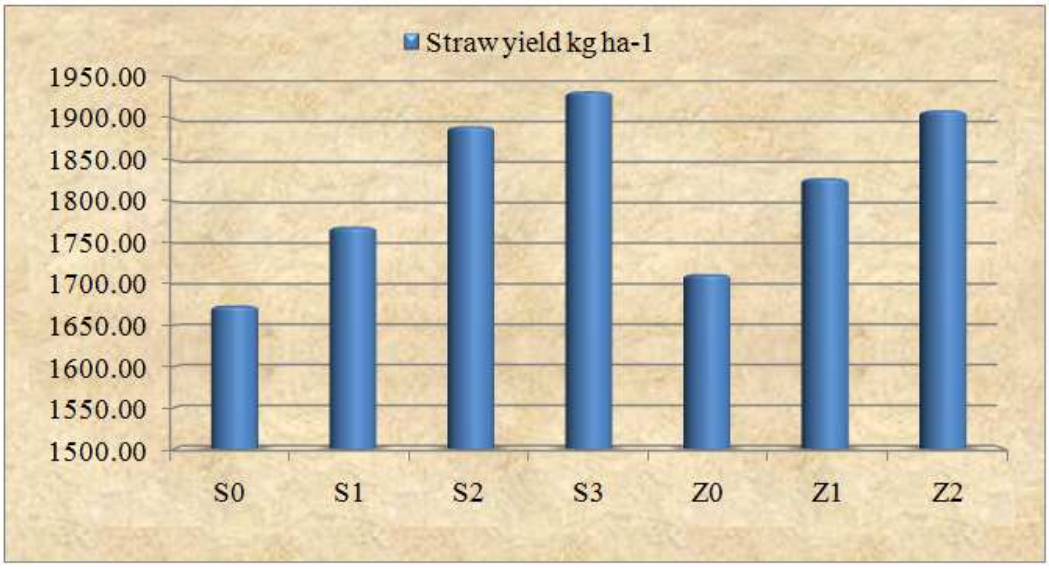

Figure 2: Effect of Sulphur and Zinc on Straw Yield (kg ha^{-1})

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